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Winter Temperature Distributions in a Three Zone Controlled ACNV Pig House

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Summary

Air temperatures recorded within a 3 zone controlled ACNV dry sow stall house, which incorporated a service area, showed that the system produced near optimum temperature control. During a period of cold weather in January the end to end variation in 24 hour mean temperatures was normally under 1°C, despite variations in the stocking density, the presence of the service area and the very sheltered exposure of the building.

Introduction

Previous studies of automatically controlled natural ventilation (ACNV), incorporating cross flow through openings running along each side wall, have revealed temperature variations of 4° to 5°C along the length of the house (Barrie & Smith, 1986). The main cause for the variation was concluded to be uneven air flow through the house as all the ventilation flaps acted together and could not, therefore, compensate for warm areas which tended to persist near the windward end wall of the building.

This paper examines one possible solution to this problem. An ACNV house was studied which has the ventilation system split into 3 separate zones and controlled by three separate thermostats exposed towards either end and central to the house. See Fig 1.

Results

A Grant Squirrel data logger recorded temperatures at 8 locations within the house every 10 minutes during the period 17-29 January 1986, see fig 2. (The logger was calibrated at the start and end of the study). During the study the stocking density frequently varied and was generally lowest in the SE corner of the building. Ambient air temperatures were recorded every 30 minutes in a grass field 150 metres to the south of the farm complex. Air temperatures were below average throughout the period with daily mean values occasionally below 0°C.

The daily mean house temperatures are given in Table 1 and typical profiles illustrated in Fig. 3.

TABLE 1 - Daily Mean Temperatures - ACNV Stall House : °C

	Internal Location									Mean Daily Ambient
Jan	1	2	3*	4	5*	6	7*	8	Range	Temp
17	18.6	18.2	19.0	18.8	19.2	19.2	19.0	19.0	1.0	5.0
18	19.0	18.4	19.0	18.8	19.4	19.4	19.4	19.4	1.0	9.6
19	18.6	18.4	19.0	19.0	19.2	19.0	19.2	19.4	1.0	5.2
20	18.8	18.2	19.0	18.6	19.2	19.2	19.0	18.8	1.0	6.6
21	18.6	18.4	19.2	19.0	19.4	19.2	18.8	19.0	1.0	2.6
22	18.6	18.2	19.0	18.8	19.2	19.0	18.6	19.0	1.0	6.2
23	18.8	18.6	18.8	19.2	19.2	18.6	18.4	19.2	0.8	3.2
24	18.8	19.4	19.0	19.6	19.4	19.0	18.8	19.6	0.8	1.4
25	18.6	19.0	19.2	19.4	19.6	19.0	19.0	19.8	1.2	-1.4
26	18.4	18.2	19.2	18.8	19.2	19.0	18.2	18.6	1.0	1.4
27	18.6	18.8	19.2	19.2	19.4	19.0	18.8	19.4	0.8	1.0
28	18.4	18.4	19.4	18.8	19.2	19.2	18.2	18.6	1.2	1.2
29	17.8	18.0	18.6	19.0	19.4	18.8	19.2	20.0	2.2	1.6

* Locations shared by house controlling sensors (all set for 20°C).

The standard deviations of the daily mean temperatures were normally 0.4 to 0.8°C but occasionally 0.8 to 1.0°C. All locations produced similar SD's with no bias of lower values on the sensors affixed to the house sensors as may have been expected, see Fig 4.

Discussion and Conclusions

The wind direction during the study was variable with a fresh SW flow between the 18th and 23rd, NW on 24th and E on 26th and 27th. The day recording the largest spacial temperature variation (29th) had light, variable winds which are unlikely to be the cause of the cool area to the west end of the house. Stock movement around the service area seems the more likely reason. This aside, the ventilation system can be seen to adapt successfully to a wide range of wind speeds*, directions and ambient winter temperatures.

Although it can be concluded that the zonal ventilation control effectively equalises the ventilation rate and thus the temperature, along the length of the house a strict comparison with the results of Barrie and Smith (1986) is not valid. The stock in this sow house is set in stalls as opposed to the finishing house were a certain amount of stock movement within the pens was possible. Nevertheless the major factor in this study is the design of the ventilation system with the pattern of stocking creating a minor effect on the results.

There was no visual evidence of hunting between the flaps in the zones where each section may be unduly influenced by the status of an adjoining system.

* NOTE: An extended period of calm or near calm winds did not occur during the period of the study.

Key Words

Animal Housing, Natural Ventilation.

Any comments or suggestions should be referred to the author.

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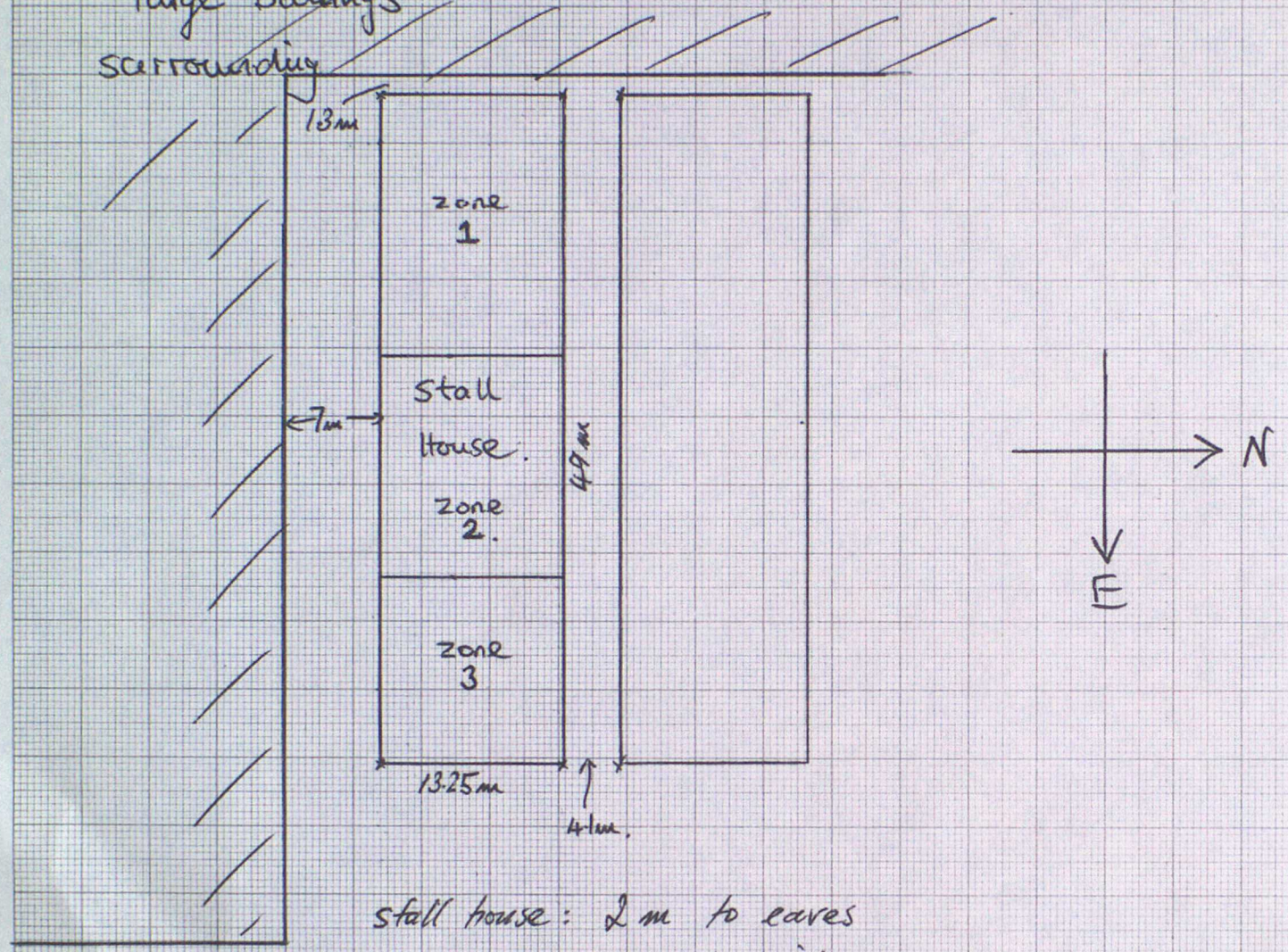
References

Barrie I. A., and Smith A. T., 1986. Winter Temperature profiles in an Automatically Controlled Naturally Ventilated (ACNV) Pig Finishing House. Farm Building Progress - to be published.

Fig. 1 Exposure and design of stall house.



stall house: 2 m to eaves
3.5m to ridge
31 vents per side wall (12+10+9)

Fig. 2. Floor plan of stall house & sensor positions.

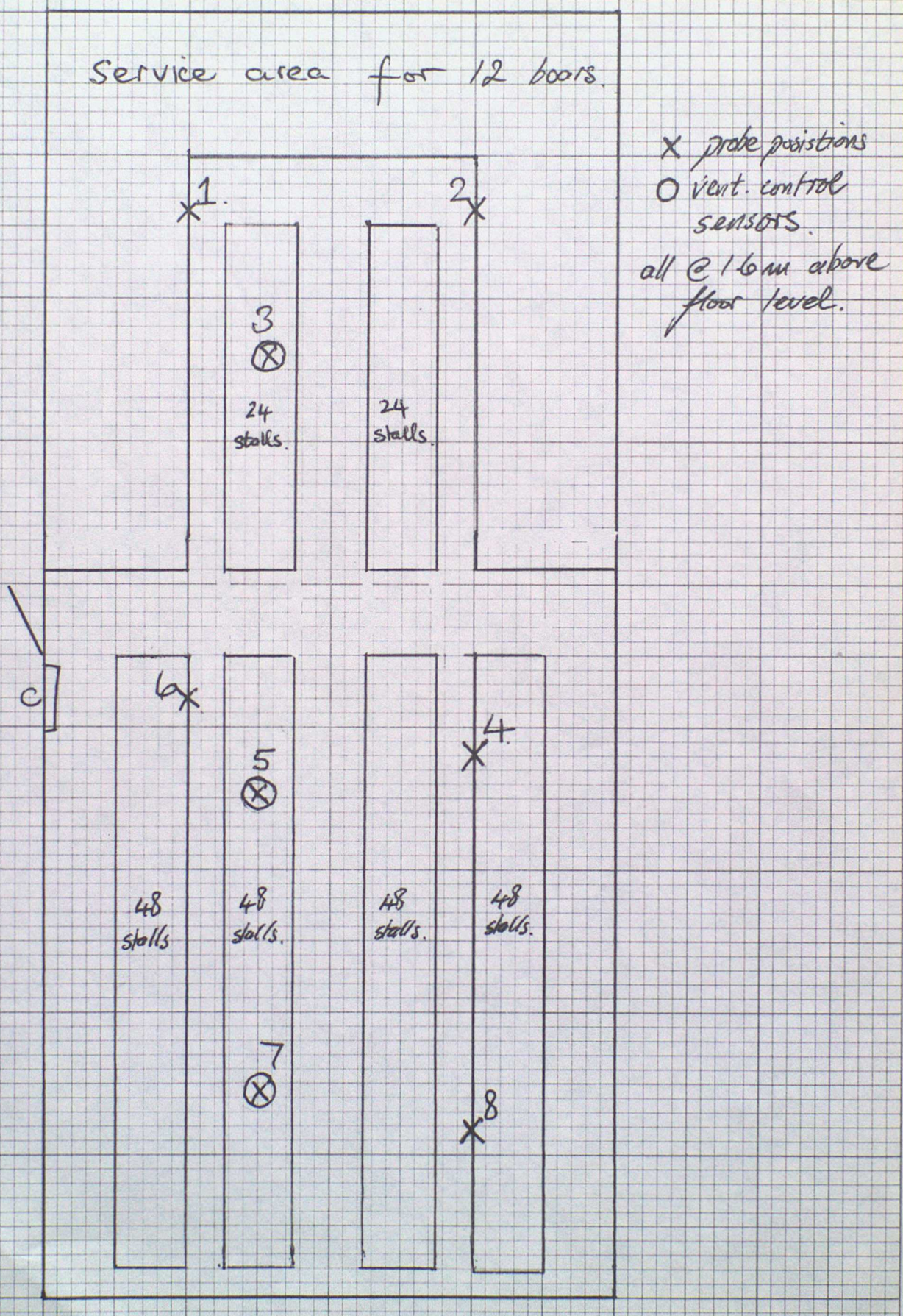
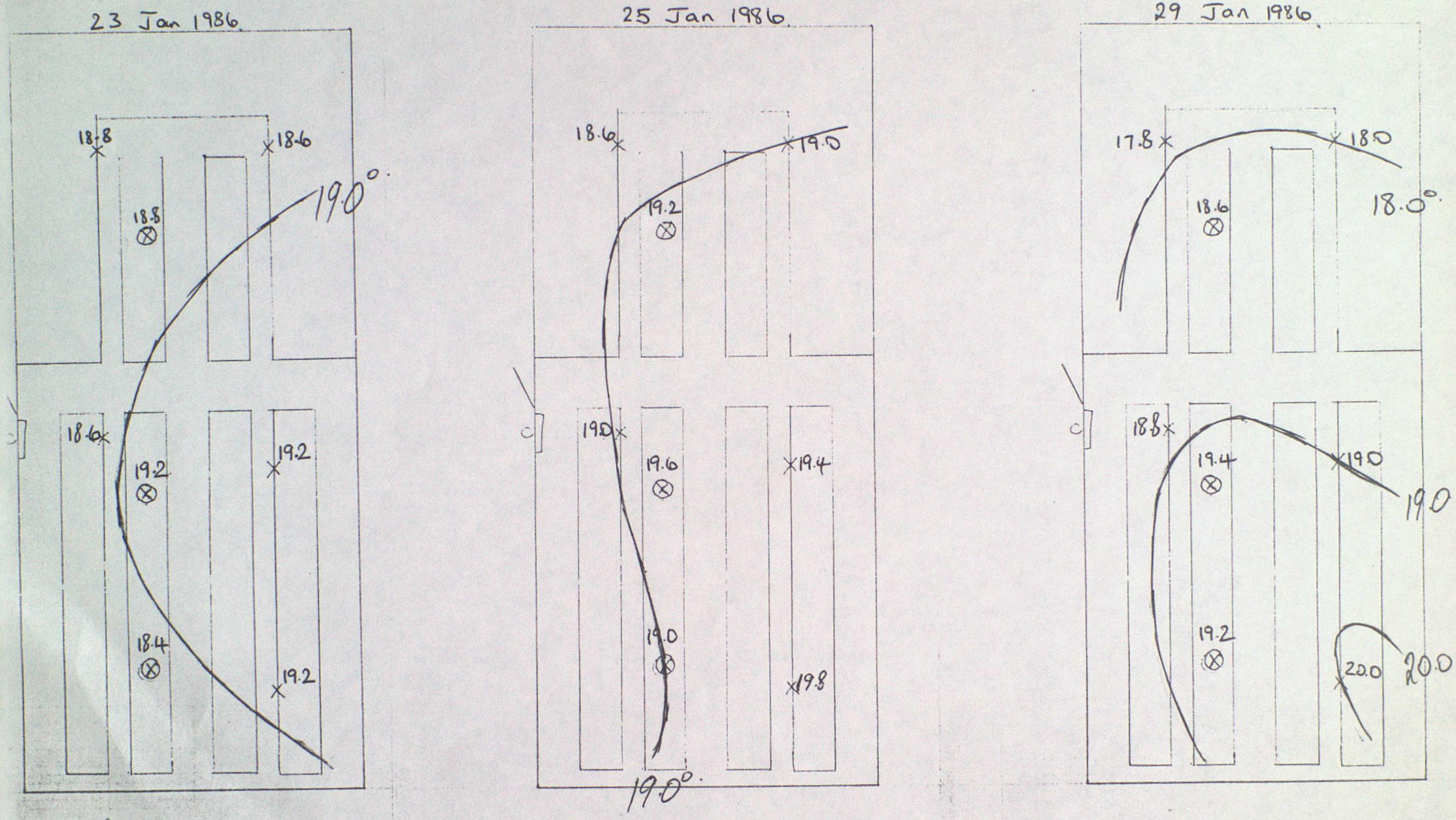
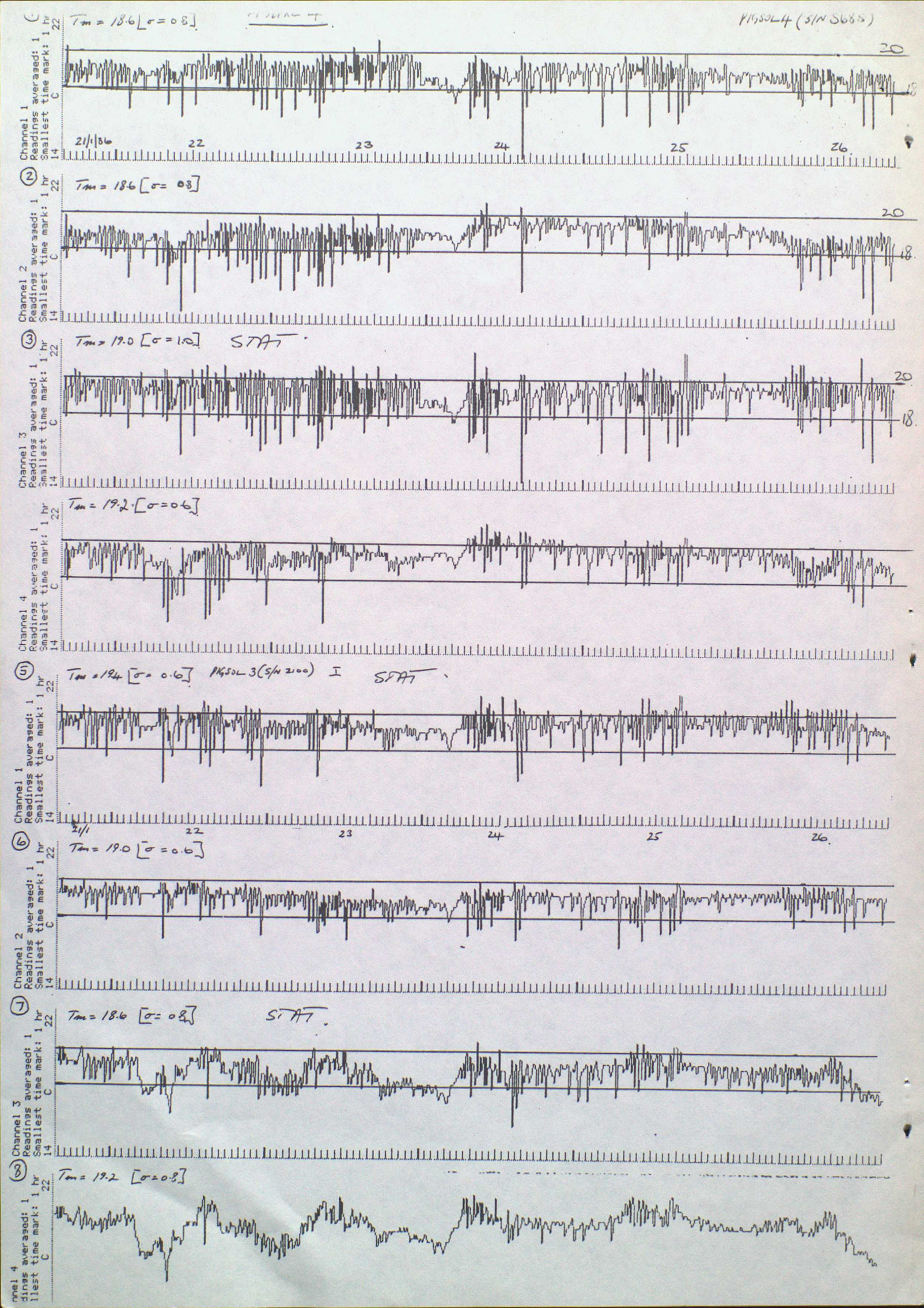


FIG. 3 DAILY MEAN HOUSE TEMPERATURES °C.




Tm = 18.6 [σ = 0.8]
PMSOL 4 (S/N 5685)
20
18
Channel 1
Readings averaged: 1
Smallest time mark: 1 hr
C
14
22
21/1/86
22
23
24
25
26
② Tm = 18.6 [σ = 0.8]
Channel 2
③ Tm = 19.0 [σ = 1.0] STAT.
Channel 3
Tm = 19.2 [σ = 0.6]
Channel 4
⑤ Tm = 19.4 [σ = 0.6] PMSOL 3 (S/N 2100) I STAT.
⑥ Tm = 19.0 [σ = 0.6]
⑦ Tm = 18.6 [σ = 0.8] STAT.
⑧ Tm = 19.2 [σ = 0.8]